

STUDIES ON NEW GUINEA MOTHS. 2. DESCRIPTION OF A NEW SPECIES OF *XENOThICTIS* MEYRICK (LEPIDOPTERA: TORTRICIDAE: ARCHIPINI)

JOHN W. BROWN, SCOTT E. MILLER, AND MARIANNE HORAK

(JWB) Systematic Entomology Laboratory, Plant Sciences Institute, Agricultural Research Service, U.S. Department of Agriculture, c/o National Museum of Natural History, Washington, DC 20560-0168 (e-mail: jbrown@sel.barc.usda.gov); (SEM) Department of Systematic Biology, National Museum of Natural History, Washington, DC 20560-0105; (MH) Australian National Insect Collection, CSIRO Entomology, Canberra, ACT 2601, Australia

Abstract.—*Xenothictis guetivora*, new species, from Papua New Guinea, is described and illustrated based on morphological characters and DNA barcode. The type series consists of 124 specimens reared from leaf-rolling larvae primarily on *Gnetum gnemon* L. (Gnetaceae), but also on *Celtis philippensis* Blanco (Celtidaceae), *Sterculia schumanniana* (Laut.) Mildbr. (Sterculiaceae), and other plants during a multi-year rearing project (1995–2001). The five previously described species of *Xenothictis* are from Australia and Melanesia.

Key Words: Malesia, Melanesia, Papua New Guinea, genitalia, pupa, *Gnetum gnemon*, *Celtis philippensis*, *Sterculia schumanniana*

The archipine genus *Xenothictis* Meyrick includes five previously described species distributed from Australia north and east to New Caledonia, Lifou (northeast of New Hebrides), Vanuatu (New Hebrides), and Fiji (see Appendix). Beyond brief original descriptions of the species, little has been published on the genus. Clarke (1958) illustrated the adult and male genitalia of *X. atriflora* Meyrick and its synonym, *X. melananchis* (Meyrick). Diakonoff (1961) illustrated the adult and male genitalia of *X. noctiflua* Diakonoff, presented brief comments on Meyrick's (1910) description of the genus, and commented on the relationship with his new genus *Xeneda* Diakonoff. Horak et al. (1996) transferred *Barnardiella sciaphila* Turner to *Xenothictis* and synonymized *Barnardiella* Turner with the latter.

Holloway (1979: 225) provided the following comment: "There is one group [of

Tortricinae] that appears to have radiated within New Caledonia and spread to other areas of the Pacific. The species are assigned at present to the closely related genera *Xenothictis* and *Xeneda* and are being studied by Mr. K. Tuck [The Natural History Museum, London] . . . who has suggested they might be congeneric. The two genera together contain at least six species in New Caledonia, two in the Loyalties and one in each of the New Hebrides and Fiji." In addition, there are several undescribed species from New Caledonia in the collection of the National Museum of Natural History, Smithsonian Institution.

During a recent (1995–2001) insect ecology project in Papua New Guinea (Basset et al. 2000; Novotny et al. 2002a, b, c), a large series of an undescribed species of *Xenothictis* was reared from several plants. The purposes of this paper are to name the



Figs. 1–2. Male and female of *Xenothictis gnetivora*. 1, Male, 2, Female.

new species, provide descriptions and illustrations of adult facies, male and female genitalia, and immatures, and to present a list of the described species of the genus. Although considerable material, including other new species, has accumulated in major museums worldwide, it is not within the purview of this paper to review this information or describe additional new species. We have not seen any other species of *Xenothictis* from New Guinea.

MATERIALS AND METHODS

General field and laboratory methods for the project are described in Miller et al. (2003) and Novtony et al. (2002a, b, c). We examined 124 pinned specimens of the new species, all of which were obtained during the rearing project in Papua New Guinea. Text descriptions are composite, based on all available specimens. Forewing measurements were made with an ocular micro-

meter under low power of a Leica MZ12© dissecting microscope. Terminology for genitalia structures follows Horak (1984). Cytochrome oxidase I (COI) sequences, DNA barcodes of Hebert et al. (2003), follow the protocols in Hebert et al. (2003).

SYSTEMATICS

Xenothictis gnetivora Brown, Miller, and Horak, new species

(Figs. 1–9)

Diagnosis.—Superficially, adults of *X. gnetivora* are characterized by a grayish brown forewing, finely and faintly reticulated with pale reddish brown throughout. Males have a bold, contrasting, blackish brown, short, slightly curved fascia originating near mid-dorsum, terminating near the middle of the discal cell; females lack the fascia. The male genitalia of *X. gnetivora* are distinguished by the narrow tegumen, simple, obovate valva with costa and

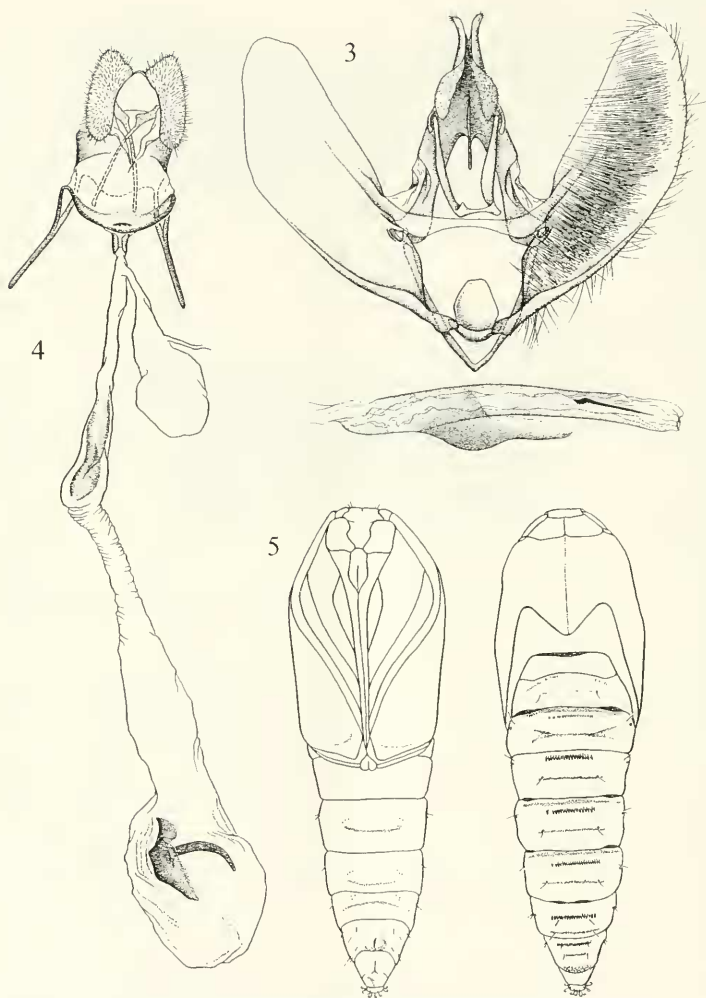
ventral margin subparallel and with extremely slender sacculus not separated by a shallow emargination from rest of valva, slender gnathos arms with cross-bar close to tips, a narrowly ovate juxta, and a long, slender aedeagus with 1–2 cornuti. Among the tortricids reared by the project team near Madang, it is distinguished by the differential coloration of the fore- and hindwings, maculation of the forewing, and the large, shiny scales on the abdomen in both sexes.

Description.—**Male.** *Head:* Lower frons pale tan to buff; upper frons slightly darker; vertex with overhanging tuft of scales short. Labial palpus short, ca. 1.0 times horizontal diameter of compound eye, robust, third segment very short; pale tan to buff mesally, pale reddish brown laterally. Antenna with two rows of dorsal scales per flagellomere, tan; cilia long, ca. 1.2–1.5 times width of flagellomere. Chaetosema well developed. Ocellus moderately large. Proboscis present, presumably functional. *Thorax:* Buff; tegula large, pale grayish brown. Forewing (Fig. 1) length 6.5–8.1 mm (\bar{x} = 7.7 mm; n = 10). Ground color grayish brown, finely and faintly reticulated with pale reddish brown throughout; a bold, short, slightly curved, blackish brown fascia originating near mid-dorsum, terminating near middle of discal cell; 4–5 extremely short costal strigulae from base to mid-costa; a small brown spot near mid-costa, an additional ill-defined costal spot ca. $\frac{3}{4}$ distance from base to apex; costal fold absent; without modified scales on underside. Fringe concolorous with ground color. Hindwing uniformly gray brown, without modified scales. *Abdomen:* Pale gray brown. Genitalia (Fig. 3; drawn from USNM slide 92771; 4 preparations examined) with tegumen narrow; a long, narrow, medial spine extending anterad from dorsal fusion of lateral halves of posterior portion of tegumen. Uncus moderately slender, bifurcate from base. Socius short, ca. $\frac{1}{2}$ length of uncus, pendant, weakly setose. Gnathos slender, arms long, weakly undu-

late, arising relatively close because of narrow tegumen; slightly and gradually convergent distally; slightly upturned and joined subdistally by transverse bar, free points short. Transtilla slender, extremely weak. Valva moderately long, obovate with costa and ventral margin roughly parallel, attenuate distally, with fine hairs throughout middle portion; sacculus simple, narrow, confined to ventral edge, extending ca. $\frac{1}{2}$ length of valva. Juxta a narrowly ovate plate. Aedeagus slender, ca. $\frac{9}{10}$ length of valva, weakly curved, attenuate in distal $\frac{1}{10}$; vesica with one or two long, slender cornuti.

Female. *Head:* Essentially as described for male, except antennal cilia short, unmodified. *Thorax:* Buff; tegula large, pale grayish brown. Forewing (Fig. 2) length 7.9–9.6 mm (\bar{x} = 8.7 mm; n = 10). Ground color grayish brown, finely and faintly reticulated with pale reddish brown throughout; 4–5 extremely short costal strigulae in basal $\frac{1}{2}$; a small brown spot near mid-costa, an additional ill-defined spot ca. $\frac{3}{4}$ distance from base to apex. Fringe concolorous with ground color. *Abdomen:* Genitalia (Fig. 4; drawn from USNM slide 82244; 6 preparations examined). Papillae anales simple, slender slipper-shaped, unmodified. Sterigma an extremely slender, broadly U-shaped band, sometimes with patch of sclerotization immediately posterad of ostium. Ductus bursae extremely long, narrow, gradually widening into corpus bursae; colliculum present immediate anterad of ostium; an irregularly-shaped sclerotized patch ca. $\frac{1}{2}$ distance from ostium to junction of ductus bursae and corpus bursae, at which point the ductus bursae is curved or weakly bent. Corpus bursae simple, ovoid, non-spiculate, with signum typically archipine with a long, strong, internal curved spine from large, strongly sclerotized, elongate diamond-shaped process on the surface of the corpus bursae.

Pupa (Fig. 5). Typically tortricine without modified head (Sohn 2002); no conspicuous sculpturing; abdomen with one



Figs. 3-5. Genitalia and pupa of *Xenothictis gnetivora*. 3. Male genitalia, with valva spread and aedeagus removed (below genitalia capsule). 4. Female genitalia. 5. Pupa, venter on left, dorsum on right.

row of spines dorsally on A3 and two rows on A4-8 in both sexes, posterior row conspicuously weaker, extremely weak on A4; spines on A9 as a small irregular patch at

posterior edge of segment; cremaster well developed with lateroposterior horns; 4 pairs of long, hooked bristles, two laterally and two mesally.

Gene sequence.—A male and a female, specimens 109973 and 120720, possessed identical COI-5' sequences (DNA barcodes), which have been deposited in GenBank under the accession numbers AY313945 and AY313944, respectively.

Type material.—Holotype, ♂, Papua New Guinea, Madang Province, Ohu Village, 5 July 1999, reared from *Gnetum gnemon*, by the project team (Novotny, Basset, Cizek, Auga, Boer, Dal, Hiuk, Isua, Kasbal, Kutil, Manumbar & Molem). Deposited in National Museum of Natural History, Washington, D.C. Project specimen 107091.

Paratypes, 51 ♂, 72 ♀. Papua New Guinea, Madang Province, Mis, Baitabag, and Ohu Villages, reared during 1995 to 2001 by the project team. All labeled with project morphospecies TORT039 (or one of the synonyms, TORT101 and TORT119), and including the following project specimens: 64808, 86216, 86817, 88484, 88170, 87565, 87554, 87700, 87545, 87719, 87631, 87695, 87672, 87285, 87480, 87292, 87454, 109523, 109529, 109527, 109538, 109521, 109542, 109130, 109317, 107600, 107359, 107596, 107461, 107454, 107370, 107419, 107598, 107323, 107364, 107365, 107470, 108953, 108955, 108867, 108915, 108857, 107931, 107987, 107870, 107864, 108796, 107829, 108918, 107849, 106999, 106960, 106990, 106973, 107037, 106938, 106834, 108459, 108262, 108482, 109973, 108367, 109995, 108585, 108579, 108454, 108945, 121278, 121049, 120702, 121101, 120737, 120577, 120995, 121425, 120977, 120869, 122699, 122951, 122449, 122346, 121662, 122474, 122587, 122485, 122383, 122080, 122591, 122058, 122477, 121602, 122081, 122400, 122374, 121579, 122578, 122762, 122024, 122023, 122430, 121603, 122510, 121606, 125410, 125185, 124501, 125172, 125182, 124979, 124887, 124820, 124880, 124597, 124648, 125489, 124661, 125116, 124757, 125024, 127025, 126975, 195727, and 195728. Project specimens 86216 and 86817 are in the PNG reference collection in the laboratory in Ma-

dang, and 195727 and 195728 are in the Australian National Insect Collection, CSIRO, Canberra. Paratypes will be deposited in the following institutions: Bishop P. Berenice Museum, Honolulu, Hawaii, U.S.A.; The Natural History Museum, London, England; Australian National Insect Collection, CSIRO, Canberra; Nationaal Natuurhistorisch Museum, Leiden, The Netherlands; National Agriculture Research Institute, Port Moresby, Papua New Guinea; Museum Zoologi Bogor, Cibinong, Indonesia; and National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A.

Distribution and biology.—All specimens are from a 25 km² area, including the villages of Mis, Baitabag, and Ohu, near Madang in Madang Province, Papua New Guinea. Our project encountered 224 larvae and successfully reared 124 adults (see Miller et al. 2003 and Novotny et al. 2002a for methods). The species feeds primarily on *Gnetum gnemon* (n = 188) (Figs. 6–7), *Sterculia schumanniana* (Laut.) Mildbr. (Sterculiaceae) (n = 25), and *Celtis philippensis* Blanco (Celtidaceae) (n = 5). We also reared adults twice from *Ficus nodosa* Teysm. & Binn (Moraceae) and once each from *Ficus variegata* Blanco, *Artocarpus communis* J. R. Forst. & G. Forst. (Moraceae), *Psychotria micralabastra* (Laut. & Schum.) Val. (Rubiaceae), and *Leucosyke capitellata* (Poir.) Wedd. (Urticaceae). Because of the low occurrence of larvae compared to the density of sampling, we do not consider the last five "normal" hosts (see Novotny et al. 2002a for discussion). Larvae were collected year-round.

Etymology.—The species name is a noun in apposition, derived from the genus of the most common larval host (*Gnetum*) and the Latin "to eat" (*vorare*).

Discussion.—*Xenothictis* are characterized by slight to moderate sexual dimorphism in forewing pattern and length; a venation with all veins separate and chorda present or at least indicated in forewing, in hindwing Rs an M1 closely approximated



Figs. 6-7. Live larvae of *Xenothictis gnetivora* on *Gnetum gnemon*. 6, On leaf surface, 7, In leaf roll.

to connate, M2 somewhat distant from connate M3 and CuA1; a very long labial palpus with a greatly enlarged, triangular third segment (not so in *X. gnetivora*); a ciliate antenna in male; a bifurcate uncus; and long, subparallel gnathos arms joined by a cross-bar. While the male genitalia of *Xenothictis* are moderately plesiomorphic, with the valva, transtilla, and aedeagus little modified, the well developed signum of the

female genitalia unambiguously associates the genus with Archipini. The absence of the second row of spines on the dorsum of abdominal segment 3 of the pupa has not previously been reported in Tortricidae and may represent a synapomorphy for the genus.

Xenothictis gnetivora differs from all congeners by its short, unmodified labial palpus in both sexes. However, wing ve-

nation, wing pattern, and genitalia of both sexes leave no doubt that *X. gnetivora* forms a monophyletic group with all other *Xenothictis* species. Its simple valva is more plesiomorphic than that of its three congeners with known males (*X. atriflora*, *X. noctiflua*, and *X. sciaphila*) and is nearly identical to that of the Australian genus *Thrincochophora* Meyrick. Further apomorphies linking *Xenothictis* to *Thrincochophora* and its sister genus *Acropolitis* Meyrick are overall very similar female genitalia and the same tegumen, juxta, aedeagus, and transtilla structure, although the latter is dentate in *Thrincochophora* and *Acropolitis*. The short labial palpus of *X. gnetivora* is similar to that of *Thrincochophora* and *Acropolitis*, suggesting that it represents the plesiomorphic character state for the group as a whole. Given the combination of morphological characters present in *X. gnetivora*, it is even more doubtful that *Xeneda*, with its modified, elongate labial palpus, should be treated as a separate genus simply on the strength of the two patches of bristles on its uncus base, leaving *Xenothictis* parapatetic and without a generic synapomorphy. It is more likely that the patches of bristles represent a species-level autapomorphy.

The rearing data on the leaf roller *X. gnetivora* are the first comprehensive biological information for the genus *Xenothictis*. There is only one host record in the Australian National Insect Collection for the Australian *X. sciaphila*, with its larva found in or on the fruit of *Musa sapientum* at Montville and Eumundi, Queensland, June 1962 and August–September 1963 by D. A. Ironside.

ACKNOWLEDGMENTS

Our colleagues Yves Basset, Vojtech Novotny, and George Weiblen collaborated at all stages of the project. Kevin Tuck assisted in identifying this species and commented on an early draft of the manuscript. Illustrations were skillfully prepared by Carolyn Darrow, Department of Systematic Biology, National Museum of Natural His-

tory, Washington, D.C. Parataxonomists John Auga, William Boen, Chris Dal, Samuel Hiuk, Brus Isua, Martin Kasbal, Richard Kutil, Markus Manumbor, and Kenneth Molem assisted with most aspects of the project in PNG. Numerous collectors, acknowledged elsewhere, assisted with insect sampling. The landowners Kiatik Batet, Hais Wasel, and Sam Guru kindly allowed us to collect on their lands. Plant taxonomists are acknowledged in Miller et al. (2003). DNA barcodes were provided by Paul Hebert and Erin Penton, University of Guelph. The following provided helpful reviews of the manuscript: F. Christian Thompson and David Smith, Systematic Entomology Laboratory, USDA, National Museum of Natural History, Washington, D.C., U.S.A.; and Kevin Tuck, The Natural History Museum, London, England. The project has been funded by U.S. National Science Foundation (DEB-94-07297, 96-28840, 97-07928, 02-11591), National Geographic Society, Czech Academy of Sciences (GA AV 651106), Czech Ministry of Education (ES 041), Czech Grant Agency (653112), International Centre of Insect Physiology and Ecology (Nairobi), and Otto Kinne Foundation. The Smithsonian Institution, Bishop Museum, and The Natural History Museum (London) provided critical facilities for the taxonomic work.

LITERATURE CITED

- Basset, Y., V. Novotny, S. E. Miller, and R. Pyle, 2000. Quantifying biodiversity: Experience with parataxonomists and digital photography in Papua New Guinea and Guyana. *BioScience* 50: 899–908.
- Clarke, J. F. G. 1958. Catalogue of the Type Specimens of Microlepidoptera in the British Museum (Natural History). Described by Edward Meyrick, Vol. 3. Published by the Trustees of the British Museum, London. 599 pp.
- Diakonoff, A. 1961. Records and descriptions of exotic Tortricoidea. *Annales de la Société Entomologique de France* 130: 49–76.
- Hebert, P. D. N., A. Cywinska, S. L. Ball, and J. R. deWaard. 2003. Biological identifications through DNA barcodes. *Proceedings of the Royal Society of London B* 270: 313–321.
- Holloway, J. D. 1979. A Survey of the Lepidoptera.

- Biogeography and Ecology of New Caledonia. W. Junk, The Hague, 588 pp.
- Horak, M. 1984. Assessment of taxonomically significant structures in Tortricinae (Lep., Tortricidae). *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* 57: 3–64
- Horak, M., I. F. B. Common, and F. Komai. 1996. Tortricidae, pp. 123–136. *In* Nielsen, E. S., E. D. Edwards, and T. V. Rangsi, eds. Checklist of the Lepidoptera of Australia. Monographs on Australian Lepidoptera 4. CSIRO, Collingwood, Australia.
- Meyrick, E. 1910. Revision of Australian Tortricina. *Proceedings of the Linnean Society of New South Wales* 35: 139–294.
- Miller, S. E., V. Novotny, and Y. Basset. 2003. Studies on New Guinea moths. I. Introduction (Lepidoptera). *Proceedings of the Entomological Society of Washington* 105: 1034–1042.
- Novotny, V., Y. Basset, S. E. Miller, P. Drozd, and L. Cizek. 2002a. Host specialization of leaf-chewing insects in a New Guinea rain forest. *Journal of Animal Ecology* 71: 400–412.
- Novotny, V., Y. Basset, S. E. Miller, G. D. Weiblen, B. Bremer, L. Cizek, and P. Drozd. 2002b. Low host specificity of herbivorous insects in a tropical forest. *Nature* 416: 841–844.
- Novotny, V., S. E. Miller, Y. Basset, L. Cizek, P. Drozd, K. Darrow, and J. Leps. 2002c. Predictably simple: Assemblages of caterpillars (Lepidoptera) feeding on rainforest trees in Papua New Guinea. *Proceedings of the Royal Society of London (B)* 269: 2337–2344.
- Sohn, J.-C. 2002. A taxonomy study on the immature stage of leaf-rolling Tortricidae (Lepidoptera) on rosaceous fruit trees in Korea. Master of Science Thesis, Kangwon National University, Korea, 151 pp.
- uardiella sciaphila* Turner, 1925, by original designation.
- atriflora* Meyrick 1930 (*Xenothictis*), *Exotic Microlepid.* 3: 609. TL: Fiji (Vunidawa). HT (male): The Natural History Museum, London.
- melananchis* Meyrick 1933 (*Xenothictis*), *Exotic Microlepid.* 4: 424. TL: Fiji (Vunidawa). HT (male): The Natural History Museum, London.
- noctiflua* Diakonoff 1961 (*Xenothictis*), *Ann. Soc. Entomol. France* 130: 66. TL: New Hebrides (Vanuatu). HT (male): Muséum National d'Historie Naturelle, Paris.
- paragona* Meyrick 1910 (*Xenothictis*), *Proc. Linnean Soc. N. S. Wales* 35: 280. TL: Lifu. HT (female): The Natural History Museum, London.
- sciaphila* (Turner 1925) (*Barnardiella*), *Trans. Roy. Soc. South Austral.* 49: 50. TL: Australia (Queensland, Toowoomba). HT (male): Australian National Insect Collection, Canberra, Australia.
- semiota* Meyrick 1910 (*Xenothictis*), *Proc. Linnean Soc. N. S. Wales* 35: 280. TL: Lifu. HT (female): The Natural History Museum, London.

Xeneda Diakonoff

- Xeneda* Diakonoff 1961, *Ann. Soc. Entomol. Fr.* 130: 62. Type species: *Xeneda coena* Diakonoff, 1961, by original designation.
- coena* Diakonoff 1961 (*Xeneda*), *Ann. Soc. Entomol. Fr.* 130: 64. TL: New Caledonia (environs of Noumea). HT (male): Muséum National d'Historie Naturelle, Paris.
- APPENDIX
- Xenothictis* Meyrick
- Xenothictis* Meyrick 1910, *Proc. Linnean Soc. N. S. Wales* 35: 279. Type species: *Xenothictis paragona* Meyrick 1910, by original designation.
- Barnardiella* Turner 1925, *Trans. Roy. Soc. South Austral.* 49: 49. Type species: *Bar-*